CEMENT AND LIME MANUFACTURE

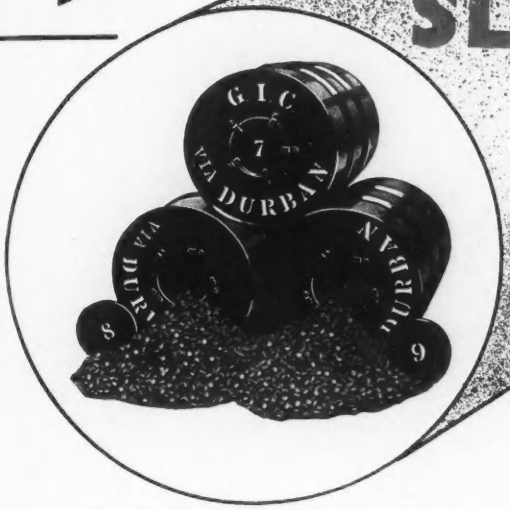
Vol. XXIII. No. 6 NOVEMBER 1950 Price 1s. Annual subscription 6s. ($1·30 in Canada and U.S.A.)

LIBRARY
FEB 5 1951
UNIVERSITY OF WASHINGTON

MINES

★ change the charge of your mills to

SLUGOIDS
Regd. 532240

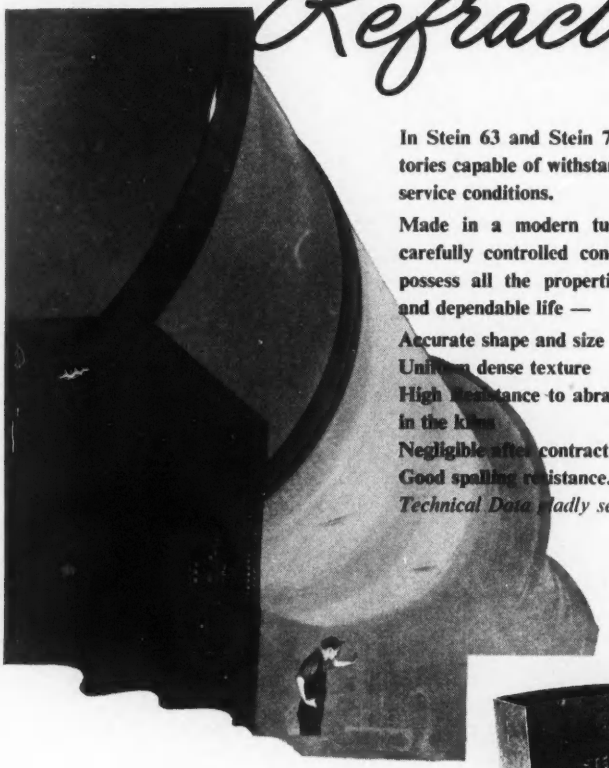


The grinding media specified for the new works of La Tolteca Compania de Cemento Portland, S.A., Mexico, and by many other leading cement makers throughout the world.

HELIPEBS LTD
PHONE: GLOUCESTER 24051
GRAMS: HOLPEBS, GLOUCESTER
PREMIER WORKS
GLOUCESTER

PUBLISHED BY CONCRETE PUBLICATIONS, LTD. 14, DARTMOUTH STREET, LONDON, S.W.1

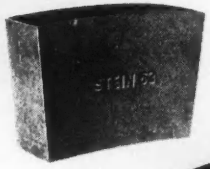
STEIN *Refractories*

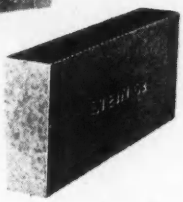


In Stein 63 and Stein 70 we offer two refractories capable of withstanding the most arduous service conditions.

Made in a modern tunnel kiln plant under carefully controlled conditions, both materials possess all the properties necessary for long and dependable life —

Accurate shape and size
Uniform dense texture
High resistance to abrasion due to hard firing in the kiln
Negligible after-contraction
Good spalling resistance.
Technical Data gladly sent on request.





We are also in a position to offer a basic lining refractory in "Stein Mag. C". This is of the Magnesite/Chrome type and can be supplied in the normal block sizes.

JOHN G. STEIN & Co LTD Bonnybridge. Scotland

CEMENT AND LIME MANUFACTURE

PUBLISHED ALTERNATE MONTHS. PRICE 1/- A COPY. ANNUAL SUBSCRIPTION 6s. POST FREE. $1·30 IN CANADA AND U.S.A.

PUBLISHED BY
CONCRETE PUBLICATIONS LIMITED
14 DARTMOUTH STREET, LONDON, S.W.1
TELEPHONE: WHITEHALL 4581.
TELEGRAPHIC ADDRESS: CONCRETIUS, PARL, LONDON.

PUBLISHERS OF
"CONCRETE & CONSTRUCTIONAL ENGINEERING"
"CONCRETE BUILDING & CONCRETE PRODUCTS"
"CEMENT & LIME MANUFACTURE"
"THE CONCRETE YEAR BOOK"
"CONCRETE SERIES" BOOKS.

VOLUME XXIII. NUMBER 6 NOVEMBER, 1950

The publishers regret that the issue of this number has been delayed by a disturbance in the London printing trade.

New Cement Works at La Tolteca, Mexico.*

Clay.

On the left-hand side of *Fig.* 13 is shown diagrammatically the arrangement of the clay plant, which is to the west of the works. A 2½-cu. yd. drag-scraper with complete equipment, comprising 3-drum haulage gear and 125-h.p. slip-ring motor and controller, was supplied by the Sauerman Drag Scraper Co. The clay is delivered to a 140-tons hopper the top of which is at ground level.

A slow-running 42-in. apron-feeder, which gives ample capacity, extracts the material from the bottom of the hopper and delivers it to a 20-in. belt-conveyor with 170-ft. centres and 11-deg. rise and travelling at 150 ft. per minute. This conveyor has a 10-h.p. drive and is carried on an open gantry with a walkway on either side. The clay is delivered on to a 30-in. picking-belt conveyor travelling at 60 ft. per minute; it is 25 ft. long and is driven by a 5-h.p. motor through worm reduction-gear. The "huesco" which the clay contains is picked by hand from both sides of the belt and is dropped immediately below and passed through a chute into small wagons. The delivery end of the picking-belt discharges into a 16-ft. diameter wash-mill manufactured by Barry, Henry & Cook, Ltd. This mill deals with 30 tons of clay per hour and produces clay-slip containing about 65 per cent. water.

The drive to the wash-mill is through a bevel wheel and pinion and V-ropes from the motor, which is a standard 170 h.p. machine identical to the others at the works. The general arrangement of this part of the plant is shown in *Fig.* 11, from which it will be seen that the substation building is alongside the buildings housing the wash-mill motor and two clay-slip pumps. The clay-slip from the mill travels in open launders to two 12-in. by 15-in. pumps, one of which is a standby. *Fig.* 11 also shows the additions required if two more kilns are installed. A second

* Concluded from September number.

wash-mill would be necessary with an additional pump and pipeline. It would also be advisable to install a 66-ft. diameter storage tank with stirring equipment and a clay-lifting wheel. Power for this substation is received at 3,000 volts from the main substation. The pumps deliver the clay-slip to the works by a 6-in. diameter pipeline about 2,300 ft. long.

At the works is a reinforced concrete storage tank 66 ft. diameter and 14 ft. 8 in. deep for clay-slip; this is sufficient for about 200 hours' supply for two kilns. The tank is fitted with stirring equipment manufactured by Head, Wrightson & Co., Ltd., comprising a revolving steel gantry which tows chains and also carries

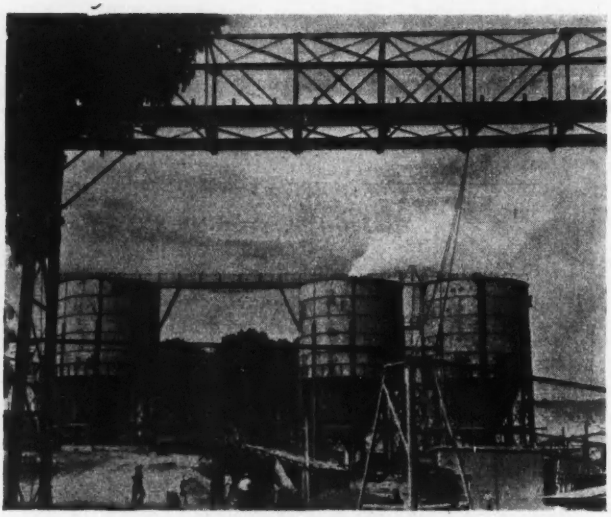


Fig. 10.—Slurry Mixing Tanks. Limestone Conveyor Gantry in Foreground.

a compressor for the air-agitation pipes. The gantry is fitted with a 20-h.p. motor.

The two centrifugal pumps used for feeding the clay-slip ring-main are Wilfley 3-in. machines (one as a standby) driven by 20-h.p. direct-coupled motors. Budenberg diaphragm pressure-gauges are used for controlling the flow to the mills so as to avoid trouble due to clogging.

Slurry Preparation and Handling Plant.

The crushed stone from the store is fed, as previously described, into a chute leading to the two wet mills, and a stream of clay-slip is directed on to it. The whole is washed into the drum-feeders on the mills. Two 800-h.p. 3-compartment mills, 7 ft. 3 in. diameter by 40 ft. long, manufactured by Ernest Newell & Co., Ltd., are installed. The graded charge of 59 tons of grinding media is about 35 per cent.

of the internal volume of the mill. The speed of rotation is 21·8 r.p.m., and the drive is central, through diaphragm couplings at each end of a torsion shaft, through an 800-h.p. continuously-rated double-helical reduction gear manufactured by Turbine Gears, Ltd. Two 800-h.p. Metropolitan-Vickers synchronous motors drive the mills and are used for power-factor correction. The lining plates of the mill were made by Hadfields, Ltd., in special hard chrome steel.

The outlet from each mill discharges through a single-deck vibrating screen [by Niagara Screens (G.B.) Ltd.] 30 in. by 80 in., with holes $\frac{3}{16}$-in. square and driven

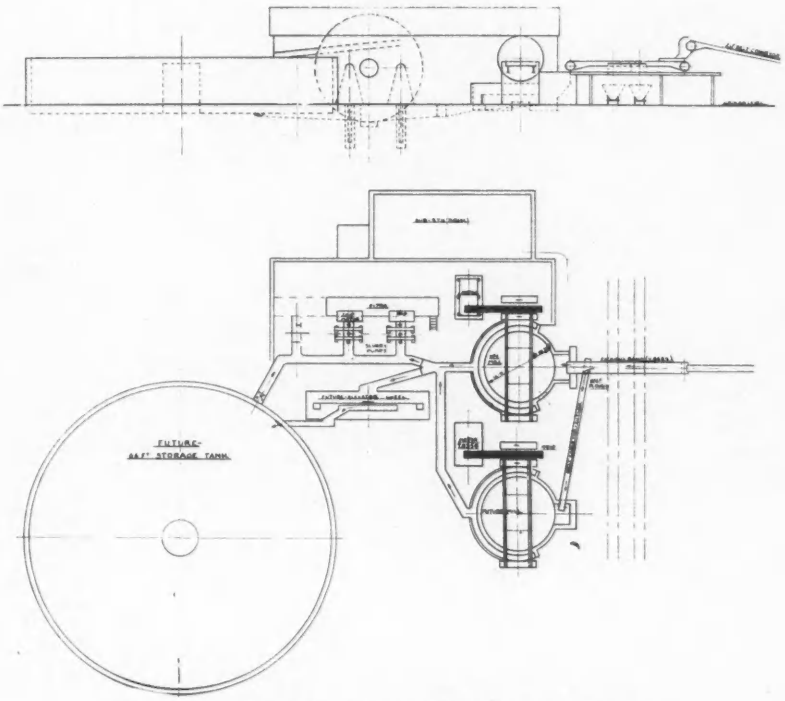


Fig. 11.—Arrangement of Clay Washmills and Pumps.

by a 5-h.p. motor through a V-rope drive. Open launders convey the slurry to a suction pit which feeds two 12-in. by 15-in. standard reciprocating pumps identical to those used for clay pumping. Here again only one pump is normally in use, the other being a standby. In *Fig.* 13 these two pumps are seen alongside the two wet mills in a pump-house, which is separate from the mill-house. It is also seen in this drawing that space is left on the south of these pumps to install three more 800-h.p. mills and additional pumps. The mill-house would then be extended

and would cover the pumps as well. At the other end of the mill-house are the two cement mills, and the space between allows for three further cement mills which would be required if four kilns were installed. A 2-tons hand-operated travelling crane with a span of 65 ft. 7 in. is used for maintenance work on the mills, and the gantry extends the full length of the building. A dividing wall separates the mill-house from the motor-house in which are the 800-h.p. syn-

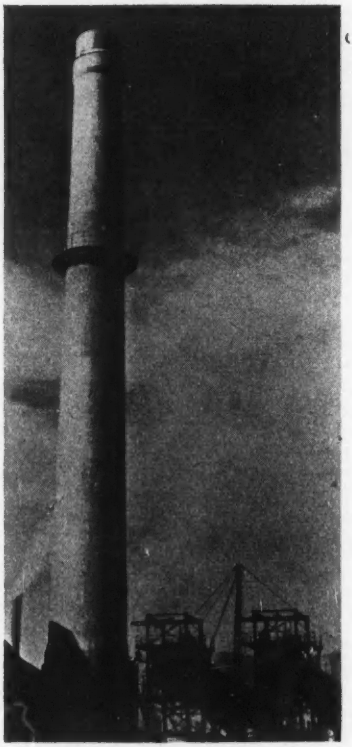


Fig. 12.—Chimney with Kilns and Back-end Structures (Flues not connected).

chronous motors mentioned previously. These machines have a 10-tons, 33-ft. 7-in. span, hand-operated travelling crane for maintenance, and the gantry extends the full length of the building. The design of the store, mill-house and motor-house is an economical one ; it was designed and fabricated by the Lambhill Ironworks, Ltd.

The slurry from the wet mills is pumped through a 6-in. pipeline to any one of three mixing tanks, which are made of steel and were riveted on the site. These

were by Whessoe Foundry and Engineering Co., Ltd., and are 50 ft. high by 30 ft. diameter with conical bottoms, and have a capacity of 23,500 cu. ft. each. The slurry in the tanks is air agitated in sequence by a relay valve made by Reavell & Co., Ltd. This valve allows a complete charge of air of any predetermined pressure to be delivered from the air receiver. The number of mixings per tank per hour is therefore dependent on the size of the air compressor, or the receiver, or the air pressure, or a combination of them all. Considerable variation can thus be effected. The air for the agitation is supplied by a 2-stage rotary air-compressor (by Hick, Hargreaves & Co., Ltd.) with a capacity of 230 cu. ft. of free air per minute at a pressure of 100 lb. per square inch; in view of the importance of this equipment a second compressor is installed as a standby. The air receiver is 5 ft. 6 in. diameter by 12 ft. high; a 65-h.p. double-ended motor drives each compressor. All this equipment is housed in a separate building near the 30-ft. diameter mixing tanks. When the slurry in these tanks has been blended it flows by gravity into one of two 66-ft. diameter storage tanks identical to the tank used for clay storage. These two storage tanks, when full, will keep both kilns in operation for at least fifty hours, and these could be supplemented by the three 30-ft. diameter mixing tanks.

The slurry from the 66-ft. storage tanks is pumped by two 12-in. by 15-in. ram pumps (one as a standby), identical with the other ram pumps on the works, to the slurry spoon-feeders made by Barry, Henry & Cook, Ltd. These normally operate at about 12 r.p.m. but are fitted with variable-speed gear-boxes supplied by Stone, Wallwork, Ltd., so that the quantity fed to the kilns can be accurately controlled. The motors driving these are 5-h.p. induction machines obtaining their power from small alternators which are chain-driven from the kiln drive-gear. This ensures a kiln feed to suit the speed of the kiln. The overflow from the spoon-feeders returns to the slurry storage tanks by gravity down steeply sloping pipes.

The Kilns.

The two rotary kilns are 350 ft. long by 10 ft. 2 in. diameter, with enlarged burning zones 11 ft. 8 in. in diameter, manufactured by Vickers-Armstrongs, Ltd. As is seen in *Fig.* 2*, they are carried on six roller bed-plates which are of particularly massive design—indeed this can be said of the whole of the kiln plant. The kiln consists of eleven sections of varying length and is largely of all-welded construction, but riveted butt straps are used to join the sections together. The chain system at the back end of the kiln was designed as a result of many years of experience at various cement works in England. A segmental ring of heat-resisting steel is used at the front end of the kiln to support the lining and withstand the effects of the hot clinker. The refractory lining of the kilns was supplied by the General Refractories Co. of Philadelphia, U.S.A. The burning zones are lined with 70 per cent. alumina 6-in. "Arcofrax" bricks and the rest of the kiln with Acine "Ranger" bricks, supplied by the same firm, except for some special bricks in the chain sections at the back end.

* Fig. 2 is in the number for September, 1950.

The drive is by a 170-h.p. slip-ring 3,000-volts induction motor, identical to the others of the same power at the works, through V-drives to a double-helical reduction gear-box supplied by Power Plant, Ltd., and thence through a torsion shaft with flexible couplings at each end to the pinion shaft of the double-reduction spur-gear provided by Vickers-Armstrongs, Ltd. The motors are provided with controllers giving seven speeds for the kilns. The top speed is 1·33 r.p.m., but the intermediate speeds can, of course, be provided only by an uneconomical use

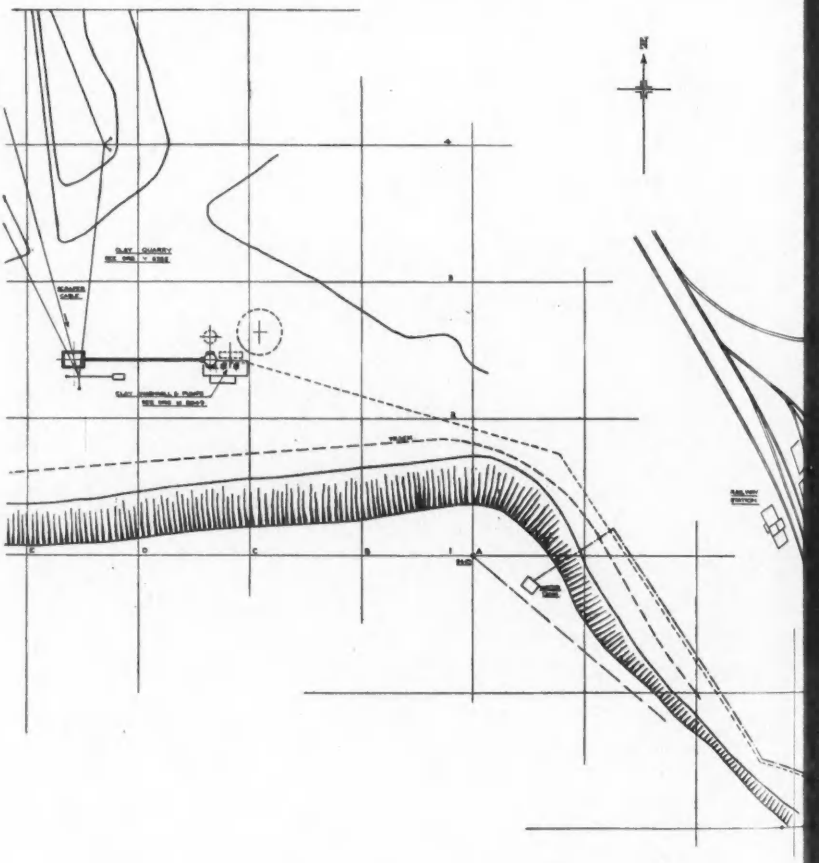
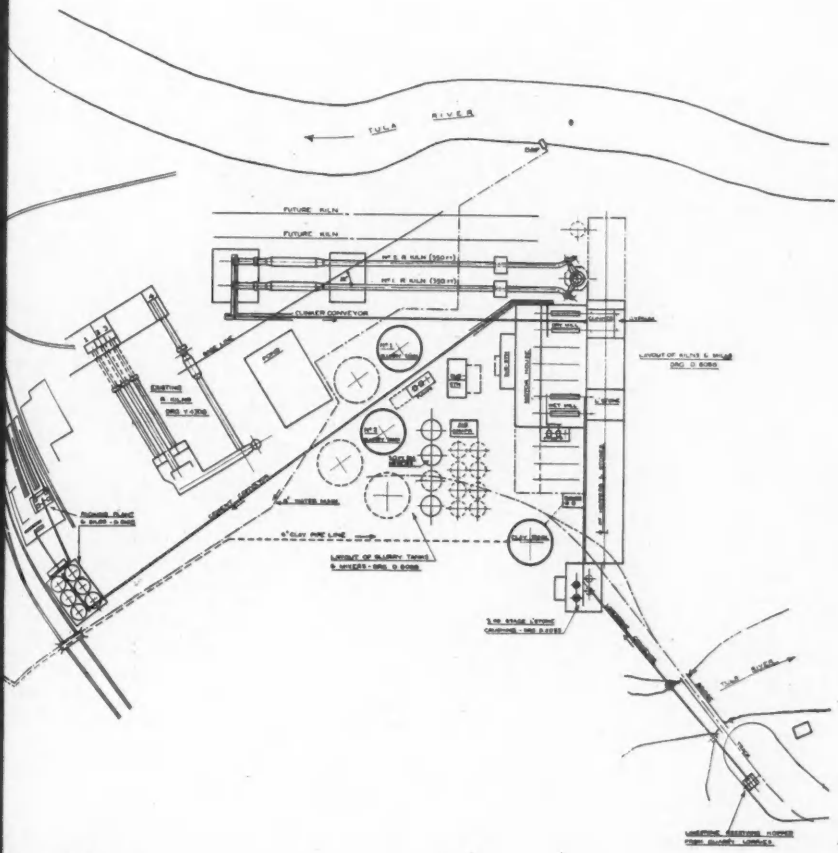


Fig. 13.—

of electricity. The direction of rotation is anti-clockwise when viewed from the firing end.

The back-end structures are of fabricated steelwork manufactured by Lambhill Ironworks, Ltd. These support the high ends of the steel flues, which are generally 7 ft. 6 in. diameter, brick lined, or lagged where brick lining is not possible. The flues are provided with expansion joints and, with their supporting structures, were manufactured by Robert Priestley, Ltd. At ground level the flues lead to



13.—New Works.

two louvre-dampers supplied by the American Blower Corporation; these are remotely controlled from the firing platform. The flues then lead to a 100-in. fan by Keith Blackman, Ltd., designed to deal with dusty gasses. The impeller is on an overhung shaft and can be easily cleaned and removed. The fan and impeller are driven at constant speed by similar 170-h.p. motors through V-rope drives, but sufficient adjustment is available on the motor to allow the three sets of pulleys to be used to get the right fan speed for normal conditions. Rectangular flues lead the gases away from the fan-discharges to the reinforced concrete chimney, which is 10 ft. diameter and 200 ft. high.

Each kiln is fitted with a type 629 Fuller cooler, each with a capacity of 15 tons per hour of clinker at a temperature of 150 deg. F., with standard control equipment and 60-h.p. motors for driving the draught-fans. The grate-control

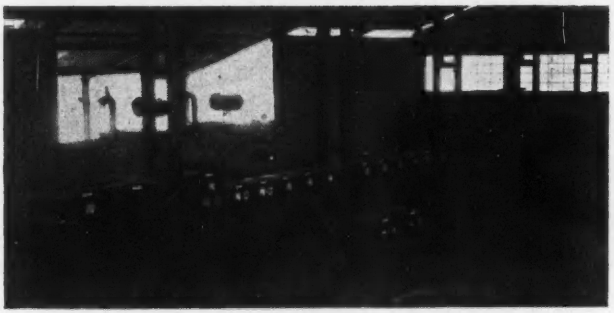


Fig. 14.—Grinding Mill Sub-station, with Lean-to over Transformers.

of the cooler is electronically operated. The outlet for the hot air from each cooler passes up a 50-ft. steel chimney manufactured by Danks of Netherton, Ltd., and sent out in parts for riveting on the site. All the electrical equipment for the coolers was supplied by the Fuller Company.

The following instruments are installed on the firing platform of each kiln: Kiln-speed control panel with variable-speed controller and revolutions per hour indicator with recorder instrument by Elliott Bros. (London), Ltd.; Induced-draught fan-control panel (Metropolitan-Vickers, Ltd.); I.D. fan-damper control panel with position indicator (Leeds & Northrup); Fuel-oil control panel (Allis-Chalmers); Fuel-oil automatic regulator and recorder (Brown Instrument Co.); Burning-zone temperature indicator and recorder ("Rayotube"); Back-end temperature indicator and "Micromax" recorder (Leeds & Northrup); Firing-hood and back-end draught recorders (Hays); Oxygen and carbon-monoxide recorders (Cambridge Instrument Co., Ltd.); Cooler-grate standard potentiometer and electronic grate-speed control panel (Fuller Co.).

Kiln Firing Plant.

The oil-firing plant for the kiln is entirely American equipment housed in a reinforced concrete building which contains the kiln-firing platforms. The

greater part of this equipment was supplied by Shellenberger, Gregg & Co., and is used in conjunction with Allis-Chalmers 13-in. mechanical vaporisers. A Johnson automatic boiler is provided for steam heating of the oil heaters in the suction and delivery side of the DeLaval fuel-oil pumps, which deliver oil to the burners at 300 lb. per square inch. Two pumps per kiln are installed (one as a standby). Oil-storage tanks with level indicators are installed, and the equipment is completed with regulation and flow valves, oil strainers, indicating and recording thermometers, and pressure gauges. Primary air for the burners is supplied by Bayley No. 70 type " H " fans driven by 75-h.p. motors operating at 1,420 r.p.m.

Clinker Conveying.

The clinker from the coolers is delivered to a 15-in. Redler conveyor 91 ft. long with a capacity of 75 tons per hour and fitted with flights of hardened material to withstand the abrasive action of the clinker. The equipment is driven by a 20-h.p. motor through a worm reduction-gear. This conveyor discharges on to a 20-in. belt-conveyor just outside the kiln-firing building and rises to the top of the clinker-store building. Its length is 536 ft. between centres and slopes up at 7 deg. inside a covered steel gantry and walkway. The drive is by worm reduction-gear fitted with a 20-h.p. motor with a belt speed of 207 ft. per minute and a capacity of 75 tons per hour. This conveyor discharges centrally between

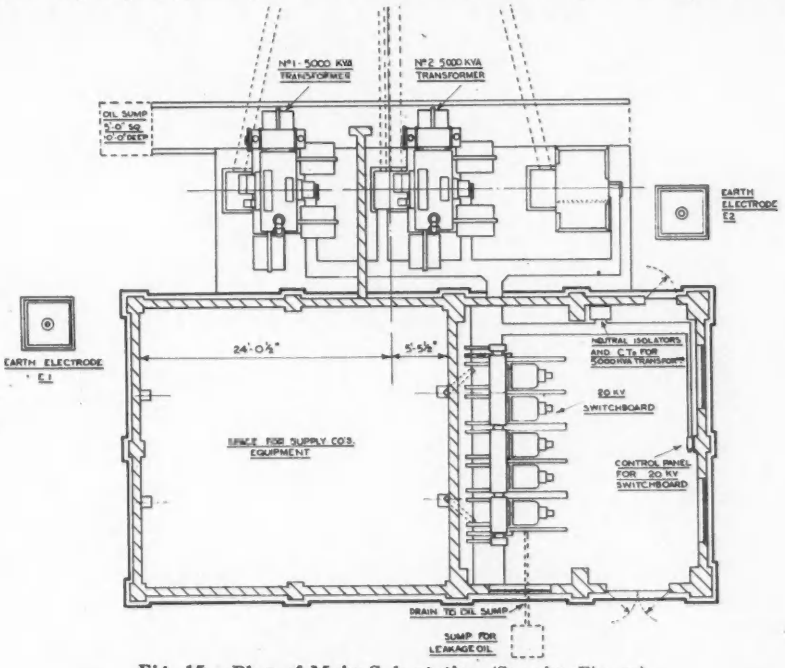

No1 - 5000 KVA TRANSFORMER
No2 5000 KVA TRANSFORMER
OIL SUMP 5'-0" SQ 5'-0" DEEP
EARTH ELECTRODE E2
EARTH ELECTRODE E1
24'-0½"
5'-5½"
NEUTRAL ISOLATORS AND C.Ts FOR 5000 KVA TRANSFORMER
20 KV SWITCHBOARD
SPACE FOR SUPPLY CO'S. EQUIPMENT
CONTROL PANEL FOR 20 KV SWITCHBOARD
DRAIN TO OIL SUMP
SUMP FOR LEAKAGE OIL

Fig. 15.—Plan of Main Sub-station (See also Fig. 17).

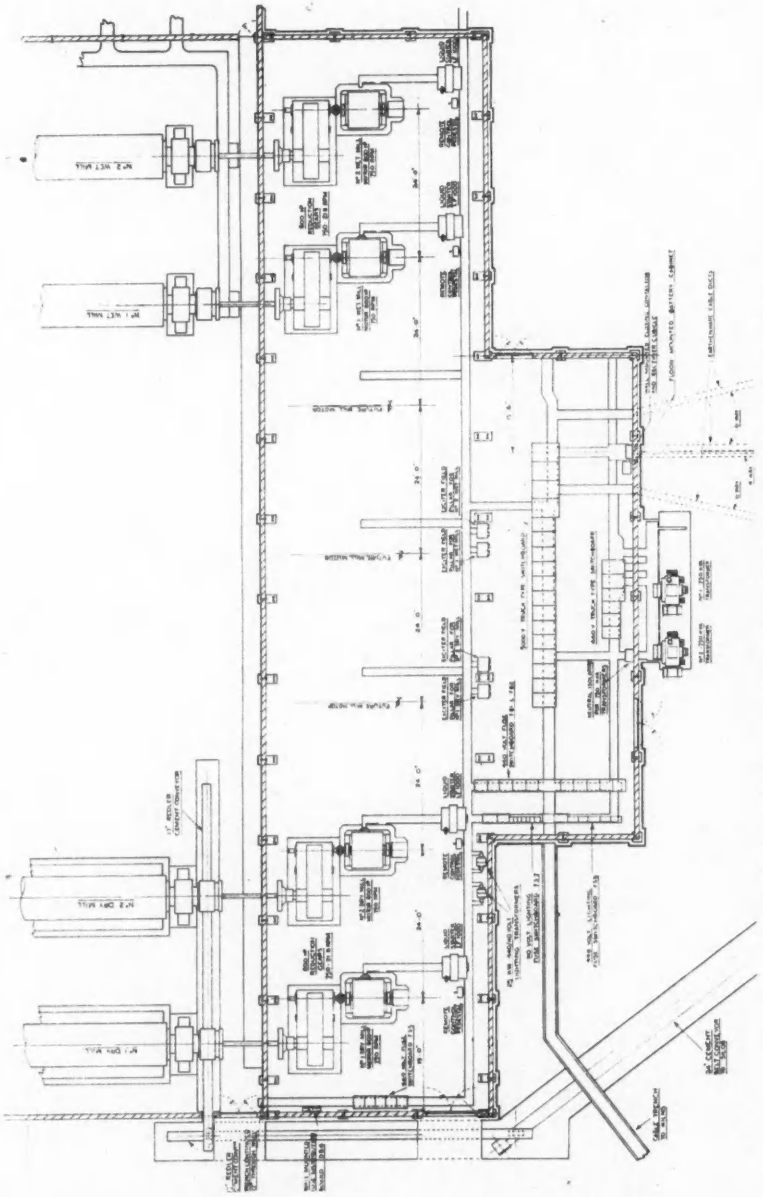


Fig. 16.—Plan of Grinding-Mill Sub-station (See also Fig. 17).

the centre-line of the two grinding mills, and normally feeds both " Feedoweights" below the mill-feed platforms. The overhead electric crane can distribute any excess of clinker evenly about the rest of the floor.

Cement Grinding and Handling Plant.

The feed arrangements have been already described under the heading Store Building. The two 800-h.p. cement mills are duplicates of the two wet mills described, except that the drum-feeder is arranged to deal with clinker and no vibrating screen is provided at the discharge end. The grinding media is of steel graded from 3½-in. balls to ½-in. by ⅝-in. slugs. The load of 51 tons represents 30 per cent. of the volume of the mill. The ⅝ in. by ¾-in. and ½-in. by ⅝-in. slugs were supplied by Helipebs, Ltd. Both mills are ventilated by Visco-Beth dust plants, each of which deals with 3,500 cu. ft. of air per minute and is equipped with a 10-h.p. and two 2-h.p. motors. The 10-h.p. motor drives the fan, one of the 2-h.p. motors drives the rapper shaft and isolating valve, and the other 2-h.p. motor drives the scavenging air-fan. The whole plant is lagged and has a thermostatically-controlled heater. Sufficient space has been left in the mill-house between the wet and dry mills to install three more 800-h.p. mills in the event of the plant being enlarged at a later date, and there is also room for three additional wet mills on the south side of the building. The dust is rapped in an isolated compartment, while the scavenging air passes through the bag filters in the reverse direction. This produces a particularly effective form of dust plant.

The cement discharged from the mills is conveyed by two 17-in. Redler conveyors 59 ft. long in series and at right angles to each other ; these are operated by 10-h.p. motors through worm reduction-gears and have an output of 75 tons per hour. The cement discharges on to a 24-in. belt-conveyor ; this is the longest conveyor in the plant, and has a length of 782 ft. between drum centres and a rise of 8½ deg. The speed of the belt is 200 ft. per minute, and the steel gantry on which it is carried is completely covered to the top of the cement silos. The motors are of 30 h.p., and the rated capacity of the conveyor is 100 tons per hour. This belt discharges into a 20-in. screw-conveyor which is situated at the centre of the block of silos already in use with the old plant ; the screw-conveyor is 57 ft. long and is operated by a 30-h.p. motor through a worm reduction-gear. Breeches chutes from this conveyor allow cement to flow to any particular silo by opening slides. The whole of this equipment is in a building on the top of the silos.

Packing Plant.

The cement is transported to the packing plant through 20-in. screws. Two screws under the centre-lines of each row of silos are 73 ft. and 76 ft. long respectively with 50-h.p. motors ; these discharge into a cross screw-conveyor 33 ft. long with a 30-h.p. motor, and in turn discharges into a screw-conveyor 106 ft. long operated by a 50-h.p. motor. All the screw-conveyors were manufactured by Barry, Henry & Cook, Ltd., and have a capacity of 120 tons per hour.

The two 20-in. slow-speed central-discharge elevators are 48 ft. 3 in. high and have a capacity of 60 tons per hour ; they were made by Barry, Henry & Cook,

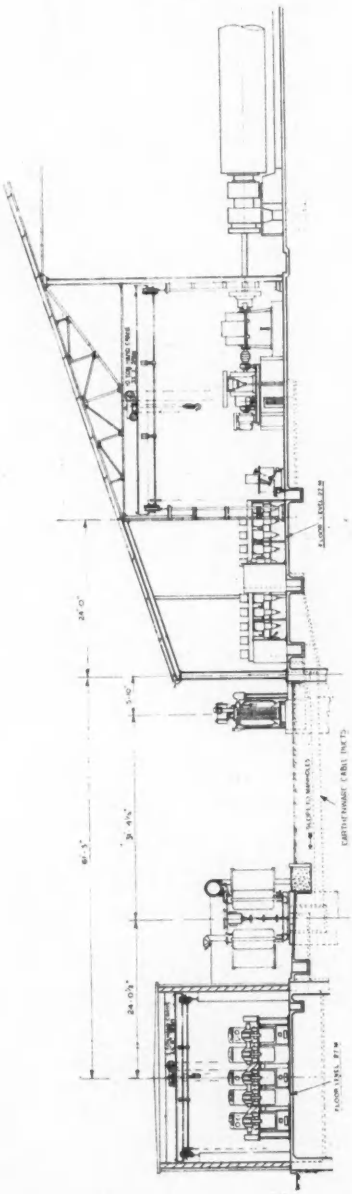


Fig. 17.—Sectional Elevation of Main Sub-station and Grinding-mill Sub-station (See also Figs. 15 and 16).

Ltd., and are operated by 20-h.p. motors through worm reduction-gears. These elevators discharge on to " Vi-King " vibrating screens (100-in. by 30-in. by $\frac{1}{8}$ in. square mesh, supplied by Darnley Taylor & Co., Ltd.), to prevent nibs from passing into the surge-hoppers feeding the 4-spout " Modern " packing machines. The screens are driven by 2-h.p. motors and the two packers by 20-h.p. motors. The packing machines are rated at 60 tons per hour. The bags coming from the packer slide down a chute the top of which is fitted with longitudinal slots. This removes most of the loose cement and prevents it being carried to the end of the conveyors, and a chute returns this dust to the bottom of the elevators. The cement bags are delivered to the railway-wagon loading-platforms on flat belt-conveyors 36 in. wide driven by 10-h.p. motors and worm reduction-gear ; they are removed from the conveyors at any point required by means of adjustable ploughs and are taken into the wagons by hand-barrow.

General.

FRESH WATER SUPPLY.—The cooling water for the kilns and mill bearings, for boiler make-up, and for general use is obtained from an artesian well giving a flow of 250 gallons per minute. Water for slurry make-up is obtained from the Tula river and pumped by two 6-in. Pulsometer 5-stage turbine centrifugal pumps through a 6-in. pipeline 2,300 ft. long to a steel storage tank of 24,000 gallons capacity supplied by the South Durham Iron & Steel Co., Ltd. The pumps are direct coupled to 45-h.p. motors operating at 1,450 r.p.m., and each has an output of 20,000 gallons per hour against a total head of 330 ft.

ELECTRICAL EQUIPMENT.—All motors, control gear, fuse switch-boards, and motors were made by the Metropolitan-Vickers Electrical Co., Ltd., unless otherwise stated. Fuse-distribution boards generally were made by the English Electric Co., Ltd. All electrical connections were supplied by Siemens Bros. & Co., Ltd., and Henleys Telegraph Works Co., Ltd., and consist of paper-insulated lead-covered armoured cables with wiped-joint terminal potheads. The whole of the equipment is in accordance with British Home Office requirements, and interlocking has been extensively used throughout the plant to facilitate operation. Electricity enters the main substation at 22,000 volts, 50 cycles, and is supplied by the Pachuca Light & Power Co. The five main breakers are type K3C 600 amperes spring-operated metal-clad draw-out pattern breakers of 350,000 M.V.A. rupturing capacity with inverse time-limit and ground-protection relays. Two 5,000 k.v.a. three-phase outdoor-type transformers, 22,000 to 3,000 volts, are supplied from this substation. From these transformers the electricity is taken to a 17-panel truck-type switchboard in the mill-house building substation. The feeder circuit-breakers on these panels are all remote controlled, and are either spring or solenoid operated. There are also two 750 k.v.a. three-phase transformers, outdoor type, 3,000 to 440 volts, fed from the switchboard first mentioned, which supply electricity to a 6-panel, 440-volt, truck-type switchboard in the building. The 440-volt low-tension feeders supply power to the various fused switchboards in different departments and sub-distribution fused boards in the plant, and also to the 25 k.v.a. single-phase lighting transformers. Plans and sections of the main substation and the grinding-mill substation are given in *Figs.* 15, 16 and 17.

Revised Continental Standards for Cement.

REVISED standard specifications for Portland cement have been issued in Roumania (1949), Poland (1950), and France (1950).

ROUMANIAN STANDARDS.—The new Roumanian standard specifications classify Portland cement in three types, namely, P300, P400, and P500. The numbers correspond to the crushing strength of mortar cubes in kilogrammes per square centimetre at 28 days. The principal chemical and physical requirements are given in *Table* 1. The initial and final setting times as determined by the Vicat apparatus are one hour and ten hours respectively. The permitted expansion in the Le Chatelier test is 10 mm. The maximum residue on a sieve having 4900 apertures per square centimetre is 15 per cent.

POLISH STANDARDS.—Two types of Portland cement (CP.250 and CP.400) and a building or masonry cement (CM.150) are described in the new Polish standard specifications. The principal requirements are given in *Table* 1. There is no restriction on the use of fillers in CM.150 so long as the cement conforms to the specified requirements. In CP.250 no admixtures other than gypsum or an hydraulic filler (not exceeding 15 per cent.) are permitted, and none (except gypsum) is permitted in CP.400. The residue on sieve No. 80μ (4900 apertures per square centimetre) must not exceed 25 per cent. for CM.150, 20 per cent. for CP.250, and 10 per cent. for CP.400. The residue on sieve No. 200μ (900 apertures per square centimetre) must not exceed 5 per cent. for CM.150, 2 per cent. for CP. 250, and 1 per cent. for CP.400. The tensile strength is determined by a bending test. The strength tests are made on prisms of mortar comprising 1 part of cement, 1 part of fine sand, and 2 parts of coarse sand.

TABLE I.

Type of Cement	Roumania			Poland		
	P300	P400	P500	CM.150	CP.250	CP.400
Maximum percentages:						
MgO	5	2·5	2·5	5	5	5
SO_3	3	2·5	2·5	3	3	3
Insoluble residue	5	1	1	—	—	1½
Loss on ignition	5	3	3	—		3
Minimum tensile strength (lb. per square inch)*:						
3 days	—	284 (20)	356 (25)	—	—	498 (35)
7 days	284 (20)	356 (25)	427 (30)	284 (20)	427 (30)	640 (45)
28 days	356 (25)	398 (28)	484 (34)	427 (30)	711 (50)	924 (65)
Minimum compressive strength (lb. per square inch)*:						
3 days	—	2845 (200)	3698 (260)	—	—	2560 (180)
7 days	2845 (200)	3983 (280)	5405 (380)	1138 (80)	1849 (130)	3983 (280)
28 days	4267 (300)	5689 (400)	7112 (500)	2134 (150)	3556 (250)	5689 (400)
Setting times:						
Initial (minutes)	60	60	30	30	40	40
Final (hours)	10	10	10	12	10	8

FRENCH STANDARDS—The revisions (January, 1950) are mainly the addition of cements of strengths greater than those specified in 1946 (see this journal for May 1947, and May and July 1949). As before, the cements are defined by the specified

* Kilogrammes per square centimetre in brackets.

strengths ; thus ordinary Portland cement is "CPA 160-250," the numerical values being the minimum compressive strength in kilogrammes per square centimetre at seven and 28 days respectively.

To the artificial Portland cements (specification P15-302) have been added a higher-strength Portland cement (215-315) and a superior Portland cement (355-500). The compressive strengths of the former are 3,058 lb. and 4 480 lb. per square inch at seven and 28 days respectively, and of the latter 5,049 lb. and 7,112 lb. per square inch. The tensile strengths of the higher-strength cement are 284 lb. and 356 lb. per square inch at seven and 28 days respectively, and of the superior cement 427 lb. and 498 lb. per square inch. The chemical and other physical requirements are the same for the new types of cement as for ordinary Portland cement. The requirements for rapid-hardening Portland cement (HRI 315-400) are unchanged.

Two types of iron-Portland cement (P15-303) are now included, namely, 160-250 as before and an improved cement, 250-315. Similarly an improved cement, 160-250, is included in the specifications for blastfurnace-slag (non-Portland) cement (P15-304), clinker-slag cement (P15-305), and masonry cement (P15-307), in each of which specifications there was previously only a 100-160 cement. To the original 50-100 lime-slag cement (P15-306), there is added a 100-160 cement of the same type. The specifications for natural cement (P15-308) and plaster cement (P15-309) are unaltered. A sulphated blastfurnace Portland cement is the subject of a new specification (P15-311). Tensile tests are not required for the foregoing cements.

To the 10-30 and 30-60 hydraulic limes (P15-310), there has been added a superior 50-100 lime.

British Standard Vicat Apparatus.

AN alteration has been made to the size of needle permitted in the Vicat apparatus for determining the standard consistency and setting time of ordinary and rapid-hardening Portland cement (B.S.12 : 1947), Portland-blastfurnace cement (B.S. 146 : 1947), high-alumina cement (B.S. 915 : 1947), and low-heat Portland cement (B.S. 1370 : 1947). The cross section of the needle can be either 1 mm. (0·039 in.) square, as in the current standard specifications, or 1·13 mm. (0·044 in.) diameter.

New Cement Works in Brazil.

A NEW cement works to be built at Salvador, Bahia, Brazil, will have a capacity of 100,000 tons annually. It is reported in " Engineering News-Record " that the raw material will be obtained from large deposits of decomposed coral. Natural gas will be used as fuel.

Recent Studies of Systems Containing Alkalis.

THE role of the alkali elements in Portland cement has become of increasing interest in recent years, due to the importance attached by some investigators, mainly in America, to a reaction that may take place between the alkalis and some siliceous aggregates. Some of the studies of the subject are reported in the "Journal of Research of the National Bureau of Standards," principally the numbers for March, 1948, and February, 1950. In the former Mr. W. R. Eubank and Mr. R. H. Bogue describe a preliminary study of portions of quaternary systems containing Na_2O and Al_2O_3, and Na_2O and SiO_2, and in the latter Mr. Eubank describes phase-equilibrium studies of quinary systems containing Na_2O, Al_2O_3, and SiO_2.

For convenience, the compounds are denoted in the following by $N=Na_2O$, $C=CaO$, $A=Al_2O_3$, $F=Fe_2O_3$, and $S=SiO_2$.

Quaternary System $Na_2O-CaO-Al_2O_3-Fe_2O_3$.—The system N-C-A-F was studied by the exploration first of the plane $C\text{-}C_4AF\text{-}(N+A_3)$ and, secondly of the planes above the base system $C\text{-}C_5A_3\text{-}C_2F$ containing successively increasing amounts of Na_2O up to 6 per cent. In the pseudo system $C\text{-}C_4AF\text{-}(N+A_3)$, the compound NC_8A_3 was found to exist as a primary phase, and the area in which the plane cuts the NC_8A_3 primary-phase volume was established. The iron phase (C_4AF solid solution) was observed to exist in a solid-solution series. In the system $N\text{-}C\text{-}C_5A_3\text{-}C_2F$ it was found that the compound NC_8A_3 appears at an Na_2O-concentration of about 4·2 per cent. However, because soda is taken into solid solution by other phases, it was not feasible, at the time, to determine the invariant point for NC_8A_3, C_3A, C_5A_3, and C_4AF-solid solution.

Quaternary System $Na_2O\text{-}CaO\text{-}Fe_2O_3\text{-}SiO_2$.—A portion of the system N-C-F-S was studied by the exploration of a plane containing 5 per cent. of Na_2O above the base system $C\text{-}C_2S\text{-}CF$. In the system $N\text{-}C\text{-}C_2S\text{-}CF$, no ternary compounds were observed up to the limit of 5 per cent. of Na_2O employed. A soda-containing phase was found to occur in solid solution with $\alpha 2CaO.SiO_2$, which may precipitate on cooling, forming inclusions in the $\beta 2CaO.SiO_2$, or enter into reaction with the glassy phase.

Quinary System $Na_2O\text{-}CaO\text{-}Al_2O_3\text{-}Fe_2O_3\text{-}SiO_2$.—Graphical and analytical means of studying the phase-equilibrium relations of the high-lime portion of the five-component system N-C-A-F-S were developed. Using the graphical procedure, compositions in two series of planes in the quinary system were investigated by the quenching method. In each of the two series one component was held constant and another given different values in successive planes. In each plane two components remained constant while three varied. In this way the minimum temperature for complete melting in each plane was determined. Data for a number of these planes were then employed to determine the quinary invariant point, which was found to have the composition 1·0 Na_2O, 48·0 CaO, 31·0 Al_2O_3, 13·5 Fe_2O_3 and 6·5 SiO_2. (The numerical values are per-

centages.) At this point the five crystalline phases, NC_8A_3, C_3A, Fe_2O_3 containing solid solution, C_2S, and C_3S exist in equilibrium with liquid.

The temperature of the invariant point was found to be 1,310 deg. ($\pm$ 3 deg.) C. Compositions including the five constituents, and approximating to that of Portland cement clinker, crystallize completely upon cooling slowly at or near 1,310 deg.C. The stable existence of the soda compound NC_8A_3 in the presence of the principal components of clinker was established. The data obtained permit a closer approximation of the amount of glass in rapidly-cooled clinker. Dicalcium-silicate and the iron-containing phase are observed to exist in various forms of solid solution.

Application of the analytical method of determining and following compositions within the quinary system was also made. Equations were developed and examples given for depicting specific planes and points within these planes in the quinary system without the use of geometrical relations. The graphical and analytical methods complement each other and together serve as a convenient procedure for studying any system of five components.

Cement Works in El Salvador.

It is reported that a new cement works in course of construction in El Salvador is expected to be completed in September, 1951. The capacity is about 40,000 tons a year.

HANDS WANTED!

WHAT kind of hands? Skilled hands — nimble hands—above all, healthy hands. Keep a special watch on those processes in which dry and wet abrasives and other irritant materials may result in dermatitis — that means hands that are lost to production. Where Rozalex barrier preparation is used, output is never endangered by dermatitis, or by the fear of dermatitis, which can be almost as crippling. Rozalex is simple to apply, and forgotten by the user when applied. There is a type of Rozalex to act as a barrier against almost every known industrial irritant. Our technical representative is at your service. Write to Rozalex Ltd., 10 Norfolk St., Manchester 2.

APPLY ROZALEX

BOOKS ON CONCRETE

"CONCRETE SERIES"

books are available on practically every aspect of reinforced concrete, precast concrete, the manufacture and chemistry of cement, and kindred subjects.

For a complete catalogue send a postcard to :

CONCRETE PUBLICATIONS Ltd

14 Dartmouth Street, London, S.W.1

England

Determination of Sulphate in Portland Cement.

AN alternative to the gravimetric method of determining the sulphate content of Portland cement is described by Smith (New York), Inc., of Long Island, N.Y., U.S.A. This is a titration method, and is said to give accurate results in less time. The method is as follows.

A sample weighing 10 gr. is finely ground and mixed with water, and solid ammonium carbonate is added. The mixture is boiled for fifteen minutes with occasional stirring; this extracts most of the sulphates present as ammonium sulphate, and converts the calcium to insoluble calcium carbonate. The mixture is then filtered, and the material on the filter washed with a little water to remove any adhering sulphates. The filtrate is evaporated by boiling on a hot-plate or steam-bath until all the excess ammonia is removed, and the evaporated solution is made up to 100 ml. in a volumetric flask. For very accurate work the material extracted with ammonium carbonate solution is dissolved in a minimum of acid, made strongly alkaline with ammonium hydroxide, and solid ammonium carbonate is added. The stirred mixture is then heated on the hot-plate until nearly boiling and is filtered. The filtrate is boiled as in the previous extraction until it is free of ammonia and is also made up to a standard volume. The SO_3 value of this second filtrate is so small and constant that it can be taken as a constant value, usually less than 2 per cent. of the total SO_3 present.

Three 10-ml. aliquot portions of the sulphate solution are taken and to each is added three different volumes of barium chloride solution representing the two extremes and one intermediate value of the SO_3 content expected. To each of the three flasks is then added 30 c.c. of isopropyl or other alcohol, one drop of 1 per cent. sodium bicarbonate solution, and five drops of tetra solution (tetrahydroxyguinone). The solution containing the largest amount of barium chloride should be red in colour, indicating that it is beyond the end-point. The flask with the least barium chloride should be yellow, showing that it is not at the end-point. If the intermediate solution is yellow, it is titrated to the end-point by adding $BaCl_2$ to the orange-red end-point. If the intermediate solution is red, then the contents of the flask whose contents are yellow are titrated to the end-point. Further aliquot portions of the sulphate solution can be taken and varying quantities of barium chloride solution added to obtain the desired SO_3 value.

If a maximum SO_3 content must not be exceeded, there is added to 10-ml. of the sulphate solution the amount of barium chloride solution representing the maximum amount of SO_3 permitted. To this are added 30 c.c. of alcohol, one drop of $NaHCO_3$ solution, and five drops of tetra. A red colour shows that the maximum is not exceeded.

For the non-routine testing of samples, a 10-ml. aliquot portion of the solution, prepared as described, is diluted with 30 c.c. of alcohol; a drop of 1 per cent. $NaHCO_3$ solution and five drops of tetra solution are added. Then 0.1N$BaCl_2$ solution is added until the vague orange-red and end-point are observed. This end-point is necessarily vague because the titration is ideal only if most of the barium chloride solution is added before the alcohol. This preliminary titration is sufficiently accurate to obtain an approximate value. In another method, the same procedure is repeated except that all but 0.1 to 0.2 ml. of $BaCl_2$ solution is added before the alcohol; following the addition of the tetra, the barium chloride is added until the orange-red end-point is observed, which will then be very distinct.

CEMENT
AND
LIME MANUFACTURE

Published by Concrete Publications, Ltd., 14 Dartmouth Street, London, S.W.1

INDEX TO VOL. XXIII, 1950

PAGE

Africa, Cement production in North 102
Alkalis in Portland cement, Determination of, by W. R. Eubank and R. H. Bogue ... 77
,, Recent studies of systems containing, by W. R. Eubank and R. H. Bogue 120
Analysis of waste gases, by E. H. Gray 55
Argentina, Cement production in 60
Ash, Improved methods of analysing 76
Australia, Cement plant for 39

AUTHORS:

Bauer, W. G., on Fluidisation applied to the lime and cement industries 33
Blaine, R. Q., and H. J. Valis, on Surface area of Portland cement 49
Boutet, M.D., on Examination of the hardening of Portland cement by an electronic microscope ... 41
Braniski, A., on Strontium and barium cements 30
Eubank, W. R., and R. H. Bogue, on Determination of alkalis in Portland cement 77
On recent studies of systems containing alkalis 120
Gray, E. H., on The analysis of waste gases ... 55
Hashimoto, K., on Japanese views on cement formulae and phase diagrams 13
Lambert, B. V., on The extraction of cement-klin dust by cyclones 61
Levin, E. M., on Nomogram for the compound composition of hydrated limes 47
Steopoe, A., on Methods of determining the insoluble residue of cement 18
Tavasci, B., on The structure of hydrated pozzolana cement 96

Barium cements, Strontium and, by A. Braniski ... 30
Blastfurnace slag, A book on 60
Brazil, New cement works in 119
Britain, Cement industry in 101
,, Research on cement in 53
British cement, Export of 46
Burning cement on a moving grate 26

Cement production abroad ... 20, 57, 60, 70, 76, 102
,, works abroad ... 40, 60, 82, 101, 102, 105, 121
,, ,, at La Tolteca, Mexico 83, 105
,, ,, at Shoreham, Sussex 21
,, ,, The cost of building 81
Chemical-resistant resin cements 4
Coarse-ground cement for experimental road ... 98
Colombia, Cement production in 60
Compound composition of hydrated limes, Nomogram for the, by E. M. Levin 47
Continuous-pressure lime hydration 69
Control of raw mixtures, Proportioning and ... 9
Cost of building cement works 81
Cyclones, The extraction of cement-kiln dust by, by B. V. Lambert 61

PAGE

Dam in Tasmania, Low-heat cement in 99
Dust by cyclones, The extraction of cement kiln, by B. V. Lambert 61

Ecuador, Proposed new cement works in 82
Eireann standard specification for cement 32
El Salvador, New cement works in 124
Extraction of cement-kiln dust by cyclones, by B. V. Lambert 61

Flotation in cement manufacture, Froth 1
Fluidisation applied to the lime and cement industries, by W. G. Bauer... 33
Formulae and phase diagrams, Japanese views on cement, by K. Hashimoto 13
French specifications, Revised 118

Gases, The analysis of waste, by E. H. Gray... ... 55
German rapid-hardening cement 59
Grate, Burning cement on a moving 26
Greece, The cement industry in... 57

Hardening of Portland cement by an electronic microscope, Examination of the, by M. D. Boutet... 41
Hongkong, Cement production in 76
Hydrated pozzolana cement, The structure of, by B. Tavasci... 96

Insoluble residue of cement, Methods of determining the, by A. Steopoe 18

Japanese views on cement formulae and phase diagrams, by K. Hashimoto... 13

La Tolteca, Mexico, New cement works at ... 83, 105
Lime and cement industries, Fluidisation applied to the, by W. G. Bauer 33
,, hydration, Continuous-pressure 69
,, works, The Hermann Goering 27
Limes, Nomogram for the compound composition of hydrated, by E. M. Levin 47
Low-heat cement for a dam in Tasmania 99
,, ,, Portland cement, Revision of British Standard for 56

Magnesian cements, Developments of... 44
,, chloride cement, Composition of... ... 19
Mexico, New cement works at La Tolteca ... 83, 105
Microscope, Examination of the hardening of Portland cement by an electronic, by M. D. Boutet... ... 41

Packing and transport of cement 100
Paper bags, Storage of Portland cement in 59
Persia, Imports of cement in 95

(continued on next page)

INDEX—*continued from previous page*

	PAGE
Phase diagrams, Japanese views on cement formulae and, by K. Hashimoto	13
Plastics, Portland cement and	56
Polish specification, Revised	118
Pozzolana cement, The structure of hydrated, by B. Tavasci	96
Proportioning and control of raw mixtures	9
Rapid-hardening cement, A German	59
Raw mixtures, Proportioning and control of	9
Research on cement in Britain	53
,, ,, ,, in Russia	71
Resin cements, Chemical-resistant	4
Road, Coarse-ground cement for experimental	98
Roumanian specifications, Revised	118
Russia, Recent research on Portland cement in	71
Shoreham, Sussex, New cement works at	21
Spain, Cement plant for	101
Specification, Eireann standard	32
,, for low-heat Portland cement, Revision of British Standard	56
Specifications, French	118
,, Polish	118
,, Roumanian	118
Storage of Portland cement in paper bags	59
Strontium and barium cements, by A. Braniski	30
Sulphate in Portland cement, Determination of	122
Sulphur trioxide, The rapid determination of	38
Surface area of hydrated Portland cement, by R. Q. Blaine and H. J. Valis	49
Tasmania, Low-heat cement for a dam in	99
Transport of cement in bulk by road	75
,, ,, ,, Packing and	100
,, ,, loose cement, by E Plassmann, E. Ruhland, and O. Farber (book review)	5
Turkeys State-owned cement works in	102
Uruguay, Laboratory equipment for	40
Vicat apparatus, British standard	119